International Journal of Agriculture and Plant Science
www.agriculturejournal.in
Online ISSN: 2664-7664, Print ISSN: 2664-7656
Received: 25-01-2024, Accepted: 18-02-2024, Published: 12-03-2024
Volume 6, Issue 1, 2024, Page No. 35-38

The Interaction of planting and weeding frequency in zero till cultivation technology on rice growth and yield

Jenal Mutakin[1], Yayan Sumekar[2]
[1] Department of Agronomy, Garut University, Indonesia
[2] Department of Agronomy, Universitas Padjadjaran, Bandung, Indonesia

Abstract
The use of a zero-till cultivation system on the same land successively causes the soil structure to become increasingly dense, which will have an impact on plant growth and yield, thus requiring different weeding. This research aims to determine the effect of the interaction of planting and weeding frequency in a zero tillage system on the growth and yield of lowland rice. The experiment was carried out from 2020 to 2022, in Cinunuk village, Wanaraja District, Garut Regency, Indonesia. The first factor is the frequency of planting in the zero tillage system (M), namely; m1 (first season planting carried out from May to September 2020), m2 (second season planting November 2020 to April 2021) and m3 (third season planting carried out September 2021 to January 2022). The second factor is weeding frequency (P), namely; p0 without weeding, p1 weeding once at 40 DAP, p2 weeding twice at 40 and 60 DAP, and p3 weeding 3 times at 20, 40 and 60 DAP. The parameters observed include; plant height, number of tillers per clump, number of panicles per clump and panicle length. The data obtained was then tested using the ANOVA test. The results of the research show that the frequency of planting lowland rice in a zero tillage system interacts with the frequency of leafing on the growth and yield of lowland rice plants. The combination of season 2 planting frequency with no weeding had the best influence on the number of tillers and the combination of season 1 planting frequency with no weeding had the best influence on the number of panicles.

Keywords: Crop season, lowland rice, soil structure, weeding frequency, zero tillage

Introduction

Rice production generally applies conventional cultivation technology. The application of this cultivation technology requires a lot of labor, especially during land processing to planting. Therefore, today's increasingly limited workforce has the impact of increasing the length of the fallow period, so that the harvest index decreases. This happens because farmers have to wait their turn to cultivate their land after harvest. Rice requires a medium with a mud structure, not land processing, therefore if the land is still in a mud structure, clean of weeds and plant residues, then rice plants can grow well. Therefore, land processing does not absolutely have to be done every planting season.

Tillage affects the process of changing soil organic matter which occurs erratically over time, from hours to years (Feng, Plante, Aufdenkampe, & Enam, 2014). Zero tillage cultivation technology can prevent soil aggregate damage and loss of soil organic C (Liu *et al*., 2006) [8]. This preservation of organic C is important for the availability of total organic C in the soil (Minasny *et al*., 2017) [10].

Zero tillage rice cultivation is the concept of cultivating rice without tilling the land first. It is only enough to clean weeds and plant residues by spraying herbicides, so that a zero tillage system can speed up the planting period, save labor, maintain soil aggregates and increase the harvest index. Ekawati (2019) [1] stated that using no-till cultivation technology can save planting time by up to 30 days. Lamid (2011) [5] stated that zero tillage cultivation technology has been proven to have many advantages including: resources and costs become more efficient, reduces greenhouse gas emissions and reduces damage to plant roots during the dry season and increases the harvest index, as well as increasing soil productivity, which has an impact towards increasing crop yields. This research aims to examine the effect of the interaction of planting and weeding frequency in a zero tillage system on the growth and yield of lowland rice

Method

The method used in this research is an experimental method using a factorial design with two factors. The experiment was carried out from 2020 to 2022, in Cinunuk village, Wanaraja District, Garut Regency, Indonesia. The first factor is the frequency of planting in the zero tillage system (M), namely; m1 (1st season planting) carried out from May to September 2020, m2 (2nd season planting) November 2020 to April 2021) and m3 (3rd season planting) carried out September 2021 to January 2022. The second factor is weeding frequency (P) that is; p0 (no weeding), p1 (weeding once at 40 DAP), p2 (twice weeding at 40 and 60 DAP), and p3 (weeding 3 times at 20, 40 and 60 DAP). The parameters observed include; plant height, number of tillers per clump, number of panicles per clump and panicle length. The data obtained was then tested using the ANOVA test with a linear model according to (Gomez and Gomez, 2007), as follows: $Yijk = \mu + Kk + \alpha i + \delta ik + \beta j + (\alpha\beta)ij + \varepsilon ijk$

Results and discussion

The frequency of planting in the zero tillage system does not interact with the frequency of weeding on plant height, however, seen from independent tests, the frequency of planting has a significant effect on the height of plants aged 20, 30 and 60 DAP, while the frequency of weeding does not show a significant effect (Table 1).

Table 1: Height of Lowland Rice Plants with zero tillage system at Planting and Weeding Frequency at 20, 40 and 60 HST

Treatment	Plant Height (cm)		
	20 DAP	40 DAP	60 DAP
Planting frequency (M)			
m0 (Conventional system) control	33.47 c	47.07 b	69.62 c
m1 (1st growing season)	34.77 c	52.78 c	66.24 b
m2 (2nd planting season)	24.66 b	37.96 a	53.82 a
m3 (3rd planting season)	19.00 a	41.55 a	62.08 b
Weeding Frequency (P)			
p0 (no weeding)	26.88 a	43.25 a	60.88 a
p1 weeding 1 time (40 HST)	27.87 a	45.32 a	62.27 a
p2 competition 2 times (40 and 60 HST)	28.21 a	45.19 a	63.63 a
p3 weeding 3 times (20,40 and 60 HST)	28.94 a	45.59 a	64.98 a

Note: The average figures in the columns marked with the same letter are not significantly different according to Duncan's Advanced Test at the 5% level.

At the ages of 20 and 40 HST, the planting frequency of the 1st season gave the highest plant effect which was not significantly different from the conventional system. This is in line with the research results of Mutakin (2020) which proves that plant height growth in the zero tillage system is not significantly different from the conventional system. This situation is due to the fact that the condition of the untreated soil structure (zero tillage in the first season) still provides a growing environment that is equivalent to that carried out by processing (conventional system), for the growth of rice roots, so that it can grow well. Plant height is a measure of growth that is most easily seen as an indicator for measuring the influence of the environment on plant growth components (Sitompul, 1995) [13].

The frequency of weeding did not show a real effect on plant height. This was because the presence of weed populations until 45 HST in rice plantings was only around 30%. This condition occurs because in the zero tillage system land preparation is carried out using herbicides. (Lamid and Wentrisno 2001) [6, 7] stated that the application of glyphosate herbicide using the recommended dose was effective in suppressing 70% of weed population growth, until the rice was 45 days after planting (DAP).

As with plant height, planting frequency in the zero tillage system does not appear to interact with weeding frequency on the growth of clump seedlings aged 20 and 60 HST. Based on independent tests on the growth of clump seedlings, the second season of planting showed the highest number of seedlings, whereas the opposite was true for plant height, the second season of planting showed shorter plant height.

Table 2: Number of Tillers per Clump of Lowland Rice Plants Zero Tillage System at Planting Frequency and Weeding Frequency Age 20 and 60 DAP

Treatment	Number of tillers (stems)	
	20 HST	60 HST
Planting frequency (M) m0 (Conventional system) control	9.08 ab	15.55 a
m1 (1st growing season)	10.40 b	26.85 bc
m2 (2nd planting season)	12.65 c	27.45 c
m3 (3rd planting season)	7.05 a	19.68 ab
Weeding Frequency (P)		
p0 (no weeding)	9.70 a	22.07 a
p1 weeding 1 time (40 HST)	9.45 a	21.57 a
p2 competition 2 times (40 and 60 HST)	9.90 a	21.55 a
p3 weeding 3 times (20,40 and 60 HST)	10.14 a	24.35 a

Note: The average figures in the columns marked with the same letter are not significantly different according to Duncan's Advanced Test at the 5% level

This may be due to the second season of planting, the soil structure was denser than in the first season, so that the planting of rice seeds in the second season was shallower than in the previous season. In shallower plantings supported by sufficient nutrients, energy will be directed more towards the formation of tillers, so that the plants will be shorter with more tillers. Planting seeds too deep will inhibit rice growth, especially root growth and tiller growth (Ibrahim, 2019) [4].

Regarding the number of tillers per hill at 40 DAT, planting frequency interacted with weeding (Table 3). In the second season of planting, with no weeding, the number of tillers was highest compared to that with weeding, whereas in the conventional combination system without weeding, the average number of tillers was lowest.

Table 3: Number of tillers per hill of Zero Tillage System Rice Plants at Planting Frequency and Weeding Frequency at 40 DAP

Weeding Frequency (P)	Planting Frequency (M)			
	m_0	m_1	m_2	m_3
p_0	9.93 a	16.27 a	29.67 b	11.10 a
	A	B	C	A
p_1	12.00 a	22.80 b	22.93 a	14.00 a
	A	BC	C	AB
p_2	11.07 a	21.27 ab	25.93 ab	13.67 a
	A	BC	C	A
p_3	17.13 b	20.87 ab	27.33 ab	14.47 a
	AB	B	C	A

Note: The average numbers in the columns marked with horizontal uppercase letters and the same horizontal lowercase letters are not significantly different according to Duncan's Advanced Test at the 5% level.

This may be due to the frequency of planting in the 2nd season, the roots are shallower than the 1st season, in this condition, if weeding is carried out, it will disturb the roots, thereby impacting the growth of the number of seedlings, whereas in the conventional system the roots are deeper and weeds grow more, resulting in Weeding treatment will have a greater impact on the growth of the number of seedlings. The growth rate of the number of off spring can be seen in Fig 1.

From Fig 1 it can be seen that in the conventional planting system (m0) an increase in the number of tillers occurs along with an increase in the frequency of weeding. This situation illustrates that in conventional systems the frequency of weeding is effective in suppressing weed growth, thus having an impact on increasing the growth of the number of seedlings per hill. Research in India shows that the result of not controlling weeds is a decrease in plant growth when compared to those treated with weed control (Patel *et al*., 2017) [12].

The frequency of planting in the zero tillage system, treatment without weeding in season 1 (m1) showed an increase in the number of tillers and increased sharply in season 2 then decreased sharply in season 3, which was followed by weeding three times and twice. When weeding once, the number of tillers increased sharply in the first season, then decreased in the second season and decreased sharply in the third season.

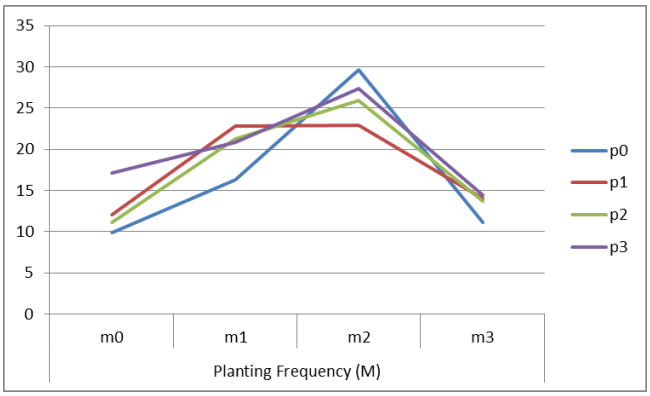

Fig 1: Growth In The Number of Tillers Per Hill of Lowland Rice Plants With Zero Tillage System on Planting Frequency and Weeding Frequency

This illustrates that the treatment of weeding paddy fields in zero tillage system planting can reduce the number of tillers. This situation can be seen from the lower number of saplings in the zero tillage system where weeding was carried out, while in those where no weeding was carried out the number of saplings showed the highest point in the 1st, 2nd and 3rd seasons of planting.

Regarding the number of panicles, the frequency of planting and weeding in the no-till system showed that there was an interaction (Table 4). The combination of 1st season planting with no weeding can produce the highest average number of panicles, this situation is significantly different from the weeding frequency of the conventional system (m0) which shows the lowest number of tillers. Thus, in a zero tillage system, labor can be saved. Meanwhile, the conventional system requires weeding so it requires more energy (Lamid, 2011) [5].

In the zero tillage system, weeding frequency does not show a real effect. This is because, after the application of herbicides in the TOT system for lowland rice, the area covered by weeds growing in rice plantations up to 45 HST is less than 30%. (Lamid 2001) [6, 7]. This situation shows that the level of competition with weeds is very low. The rate of number of panicles in the combination of planting and weeding frequency can be seen in Fig 2.

Table 4: Number of Panicles for Rice Plants in Zero Tillage System on Planting Frequency and Weeding Frequency

Weeding Frequency (P)	Planting Frequency (M)			
	m_0	m_1	m_2	m_3
p_0	9.87 a A	24.43 b C	18.73 b B	13.00 a A
p_1	10.33 a A	16.53 a B	18.87 b C	13.40 a A
p_2	13.20 a A	21.47 ab B	14.80 a A	13.93 a A
p_3	14.60 a **A**	22.13 b B	12.73 a A	13.87 a A

Note: The average numbers in the columns marked with horizontal uppercase letters and the same horizontal lowercase letters are not significantly different according to Duncan's Advanced Test at the 5% level.

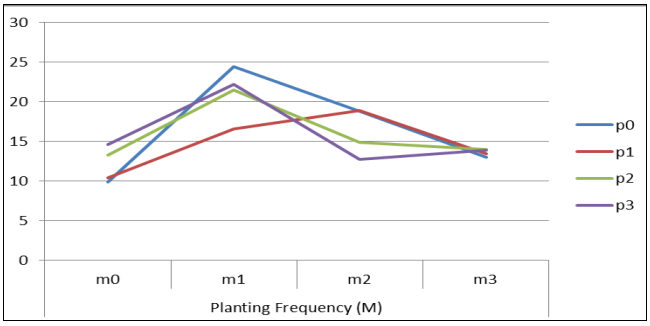

Fig 2: Rate of Number of Panicles for Rice Plants in Zero Tillage System on Planting Frequency and Weeding Frequency

From Fig 2 it can be seen that the frequency of planting affects the frequency of weeding. In conventional planting systems (m0) an increase in the number of panicles occurs along with an increase in the frequency of watering, research by Tamang *et al*. (2015) weeding frequency treatment carried out at 20 and 40 HST can suppress weed growth by 66.33% and increase yields by 52.57%, and weed free treatment can suppress weed growth by 95.94% and increased yield by 54.23% compared to treatment without weed control.

In the no-till planting system, the treatment without weeding in the first season (m1) showed the highest number of panicles, which then decreased in the second planting season which decreased sharply until the third planting season, this decrease was followed by treatments with a decreasing frequency of 2 and three times weeding. tantan in the second planting season, which then increased again in the third planting season. while one-time weeding increased in the first season and fell slightly in the 2nd season then decreased sharply in the 3rd growing season. This decrease occurred along with the treatment without weeding. All weeding frequency lines finally met at one point in the 3rd planting season, thus forming a line cuts at several points. The highest number of panicles, 22.13, occurred at point m1p3.

This illustrates that weeding rice in a no-till planting system can reduce the number of panicles. This situation can be

seen from the lower number of panicles in the zero tillage system where weeding was carried out, while those where no weeding was carried out showed the highest number of panicles in both the second and third planting seasons.

The results of statistical analysis regarding the effect of planting and weeding frequency on panicle length in the zero tillage system at harvest are presented in Table 5. Based on the results of the statistical analysis it turns out that there is no interaction between planting frequency and weeding frequency on panicle length per hill in the zero tillage system, however, independent planting and frequency delivery technologies display significant differences.

Table 5: Panicle Length of Lowland Rice Plants Zero Tillage System on Planting Frequency and Weeding Frequency

Treatment	Panicle length (cm)
	100 DAP
Planting frequency (M)	
m0 (Conventional system) control	21.72 b
m1 (1st growing season)	21.96 b
m2 (2nd planting season)	20.54 a
m3 (3rd planting season)	23.08 c
Weeding Frequency (P)	
p0 (no weeding)	20.98 a
p1 weeding 1 time (40 HST)	22.43 b
p2 competition 2 times (40 and 60 HST)	21.92 a
p3 weeding 3 times (20,40 and 60 HST)	21.98 a

Note: The average figures in the columns marked with the same letter are not significantly different according to Duncan's Advanced Test at the 5% level

In Table 5 it can be seen that the planting frequency for season 3 (m3) shows an average of the longest panicles which is significantly different from other planting seasons. This illustrates that planting frequency has a significant effect on panicle length. The weeding frequency p0 (frequency without weeding) shows the average longest panicle which is significantly different from other weeding frequencies. From Table 5 it is known that the 3rd planting season provides the longest panicle effect when compared to other planting seasons. This may be due to the fact that in the third planting season the soil was able to increase soil aggregates and organic C, so that the soil remained fertile. Zero tillage can suppress soil damage, increase soil aggregation and can conserve and/or accumulate soil C-Organics (Luo, Wang, & Sun, 2010) [9]. In fertile soil conditions, if the plant does not form many tillers, the soil fertility of the plant will encourage the formation of longer panicles from the parent plant.

In terms of weeding frequency, the one-time weeding treatment at 40 DAP (p1) gave the longest panicles compared to other weeding treatments. This indicates that weeds in zero-till rice fields are controlled only once during growth (Lamid, 2011) [5]

Conclusion

The frequency of planting lowland rice in a zero tillage system interacts with the frequency of drying on the growth and yield of rice plants. The combination of second season planting frequency with no weeding had the best effect on the number of tillers and the combination of season planting frequency 1st without weeding has the best effect on the number of panicles.

References

1. Ekawati FY. Cultivation Techniques Without Tillage. Pusluhtan Ministry of Agriculture. Jakarta, 2019.
2. Feng W, Plante AF, Aufdenkampe AK, Six J. Soil organic matter stability in organo-mineral complexes as a function of increasing C loading. Soil Biology Biochemistry,2014:69:398–405.
3. Gomez KA, Gomez AA. Prosedur Statistik untuk Penelitian Pertanian: Edisi Kedua. Terjemahan Endang Sjamsuddin dan Justika S.B. UI-PRESS: Jakarta [ID], 2007.
4. Ibrahim. Pandan Putri Rice Cultivation Techniques. Personal Communications. Warungkondang, Cianjur, 2019.
5. Lamid Z. Integration of weed control and no-till technology in lowland rice farming facing climate change. Agricultural Innovation Development,2011:4(1):14-28.
6. Lamid Z. Progress Report on the Use of Herbicides Polaris 240 AS/ Polado 240/105 AS with a Long-Term No-Tillage System in Paddy Rice. Monagro Chemical Collaboration and Sukarami Agricultural Technology Research Center, Solok, 2001.
7. Lamid Z, Wentrisno. Land preparation technology without tillage (TOT) for the cultivation of rice, soybeans and corn. In: Rangkuti M, Rusastra IW, Limbongan J, Slamet M, Syam A, Bulo D, editors. Proceedings of the National Seminar on Strengthening Recommendations for Agricultural Technology Packages and Food Security in the Era of Regional Autonomy. Center for Agricultural Socioeconomic Research and Development, Bogor, 2001, 85-76.
8. Liu X, Herbert SJ, Hashemi AM, Zhang X, Ding G. Effects of agricultural management on soil organic matter and carbon transformation - a review. Plant, Soil Environ,2006:52:531–543.
9. Luo Z, Wang E, Sun OJ. Can no-tillage stimulate carbon sequestration in agricultural soils? A meta-analysis of paired experiments. Agriculture Ecosyst Environ,2010:139:224–231.
10. Minasny B, Malone BP, McBratney AB, Angers DA, Arrouays D, Chambers A, *et al*. Soil carbon 4 per mille. Geoderma,2017:292:59–86.
11. Mutakin J. Weed Diversity, Growth and Yield of Lowland Rice in Different Planting and Weeding Systems. Jagros,2020:4(June 2):2020.
12. Patel RI, Patel CK, Patel NV, Rabari KV. Influence of Nutrient, Weed and Pest Management Practices on Performance of Mungbean (Vigna radiate L.). International Journal of Environmental Science,2017:6(4):2622-2630.
13. Sitompul SM, Guritno B. Plant Growth Analysis. Gadjah Mada University Press. Yogyakarta, 1995. p,24.
14. Tamang D, Nath R, Sengupta K. Effect of Herbicide Application on Weed Management in Green Gram (Vigna radiata L. Wilczek. Advances in Crop Science and Technology,2015:3(2):1-4.